MIO Cortex: Memory Mechanisms for Operator-Expert Networked Decision Support

Dr. Alex Bordetsky, Professor
Steven Mullins, PhD student
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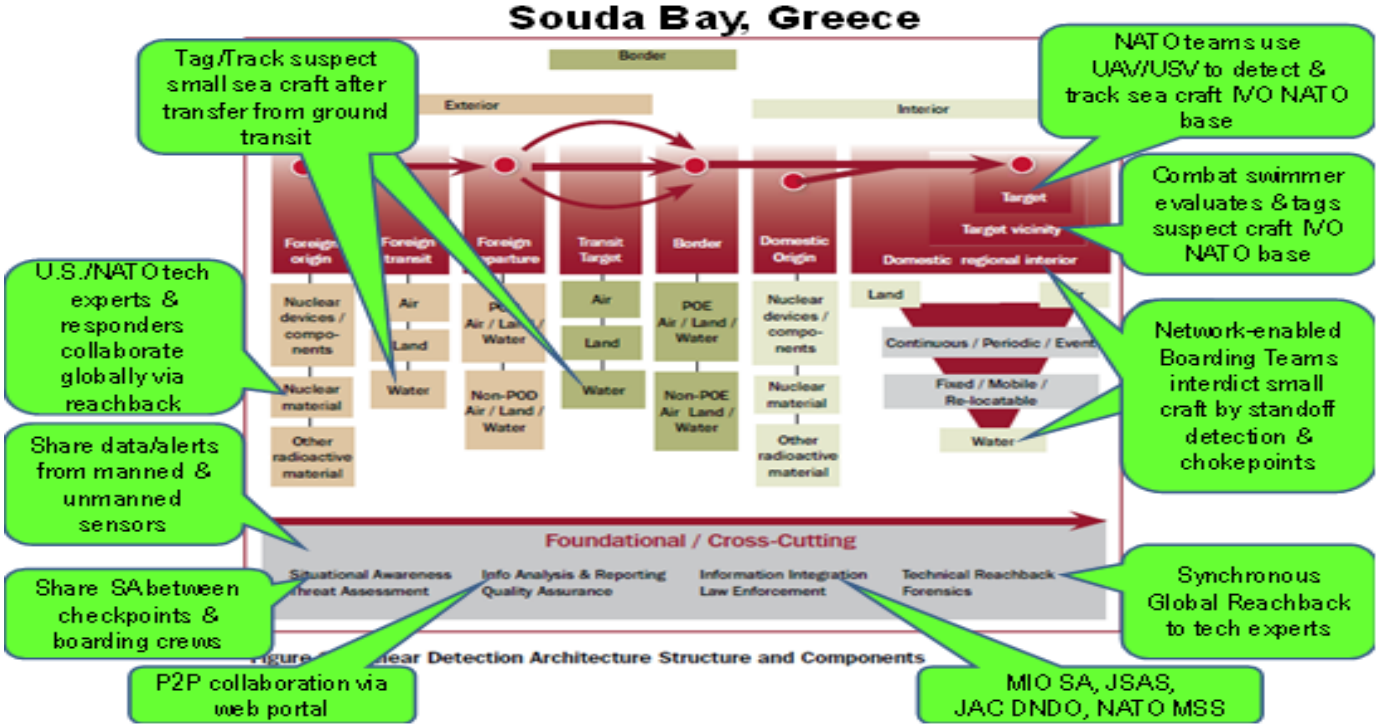
CENETIX - Background

- **Who:** Since 2010, researchers led by the U.S. Naval Postgraduate School has conducted a series of experiments at the CEnter for NETwork Innovation and eXperimentation
- **Objective:** specifically address the threats to the U.S. and NATO installation overseas.
- **Purpose:** examine NWDSS means to detect and interdict nuclear and radiological materials.
- **Where:** portions of the Baltic and the Mediterranean Seas.
- **Results:** operational models which contribute (green inserts) to development of the GNDA*



TMS as Network - Characteristics

Processes

1. Directory Updating
   - Knowing who knows who in a group
2. Information Allocation
   - Assigning memory items to specific group members
3. Retrieval Coordination
   - Accessing or retrieving knowledge by leveraging who knows what

As a Knowledge Mesh Network

- Knowledge Distribution (implicit/explicit)
- Knowledge Links (strong/weak)
- Knowledge Flow/Transfer
- SME Reachback

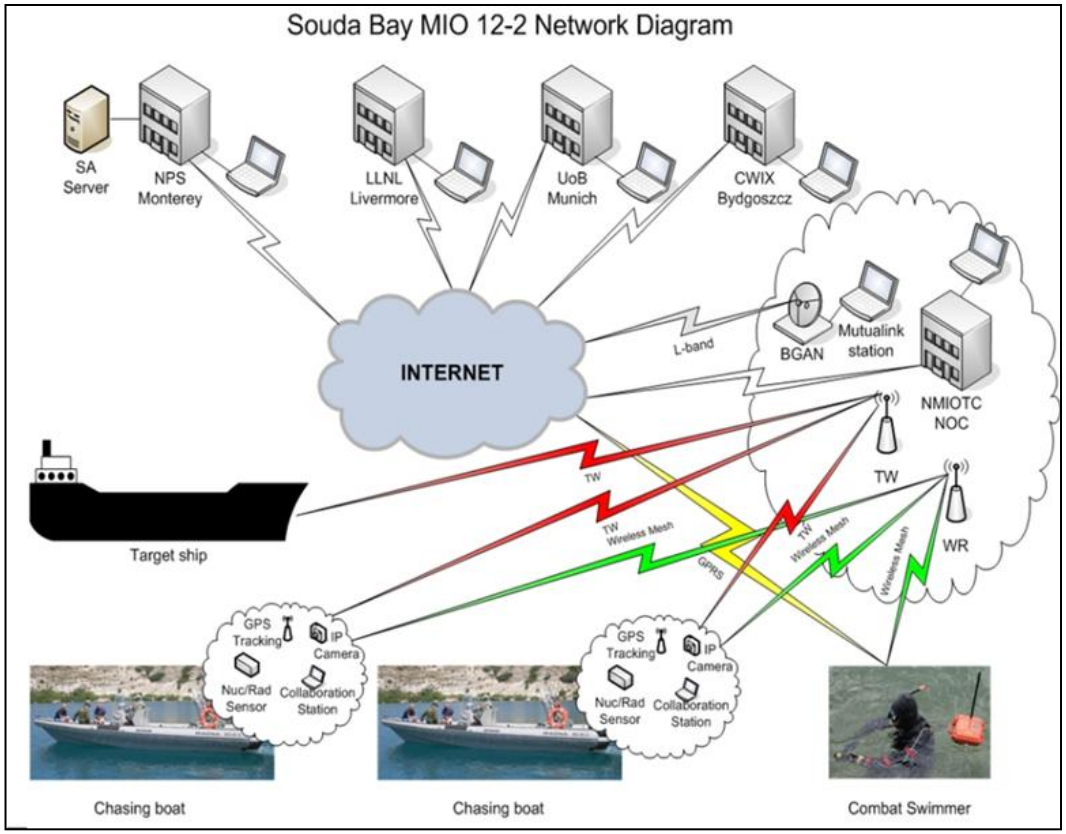
Campaign of Experimentation - MIO

We are examining:

- Phenomenon and functionality of a *memory system* capable of supporting collective expert networks
- Networked decision support in the context of a maritime interdiction operation (MIO). Two dimensions of knowledge in such networked DSS:
  - *social or organizational memory* as exemplified by reach back to subject matter experts
  - *software encoded knowledge bases* distributed across a MIO services network.
- A *transactive memory system (TMS)* as a mechanism unifying network knowledge formation, generation, flow/sharing, retrieval, use; a knowledge network that –
  - *forms and evolves* through the process of discovery and
  - forms *strong/weak ties* between info sensors and expert nodes, producing shared analyses.
- *Clustering* in social networking between mobile operators and reachback experts
- And describe the potential architecture of a *human-machine "cortex"* using a MIO-related social network.

Some Characteristics of Operator-Expert Knowledge Network Nodes

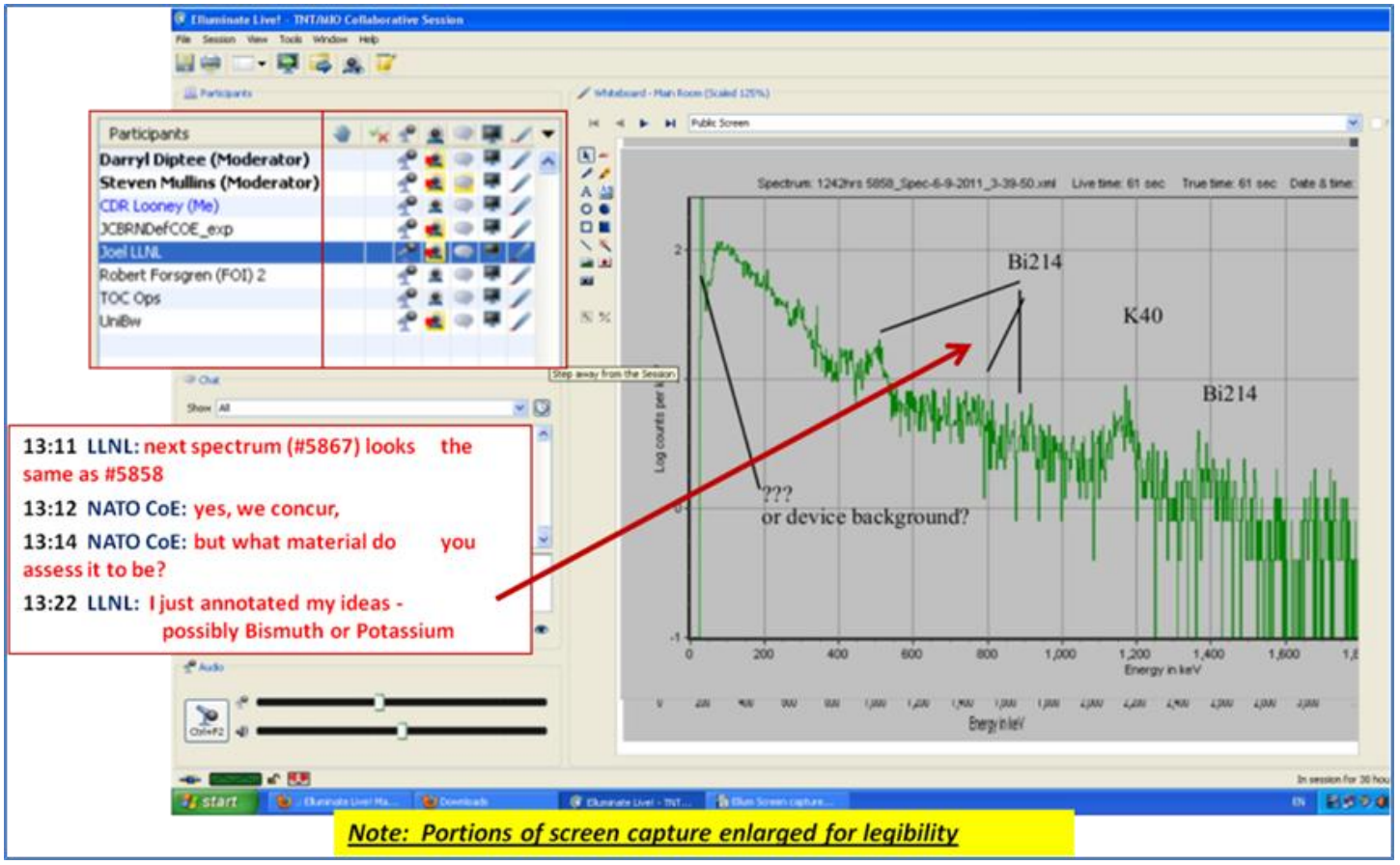
- Transient Membership
- Heterogeneity
- Homophily*
- Memory



* Hawkins, J. and Blakeslee, S. (2004) *On Intelligence.* St. Martin's Griffin, NY.

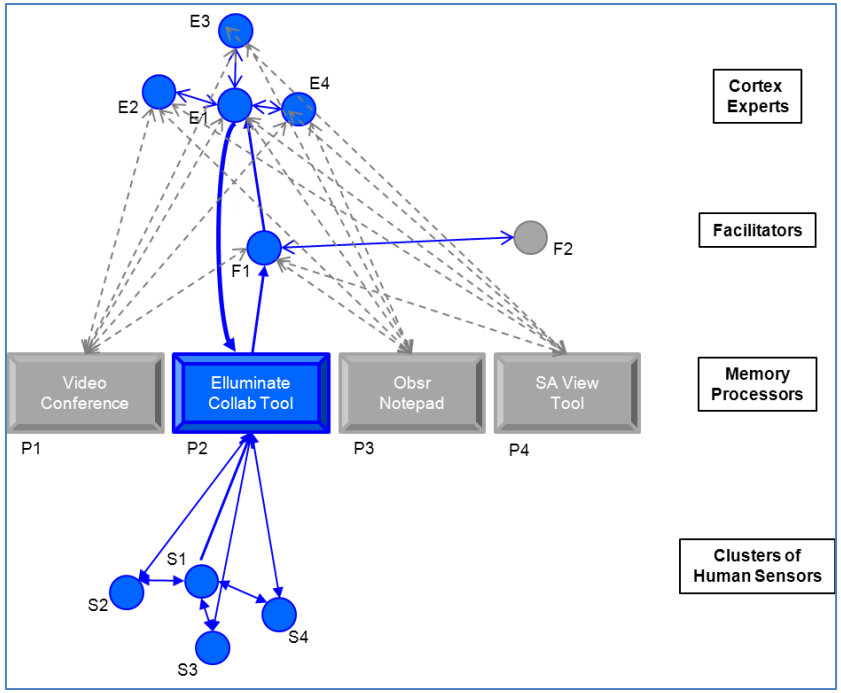
Cortex Model of MIO Transactive Memory: centered on a Whiteboard

There is a correspondence between a human sensor-to-processor-to-cortex* and a network as identified through observations in experiments



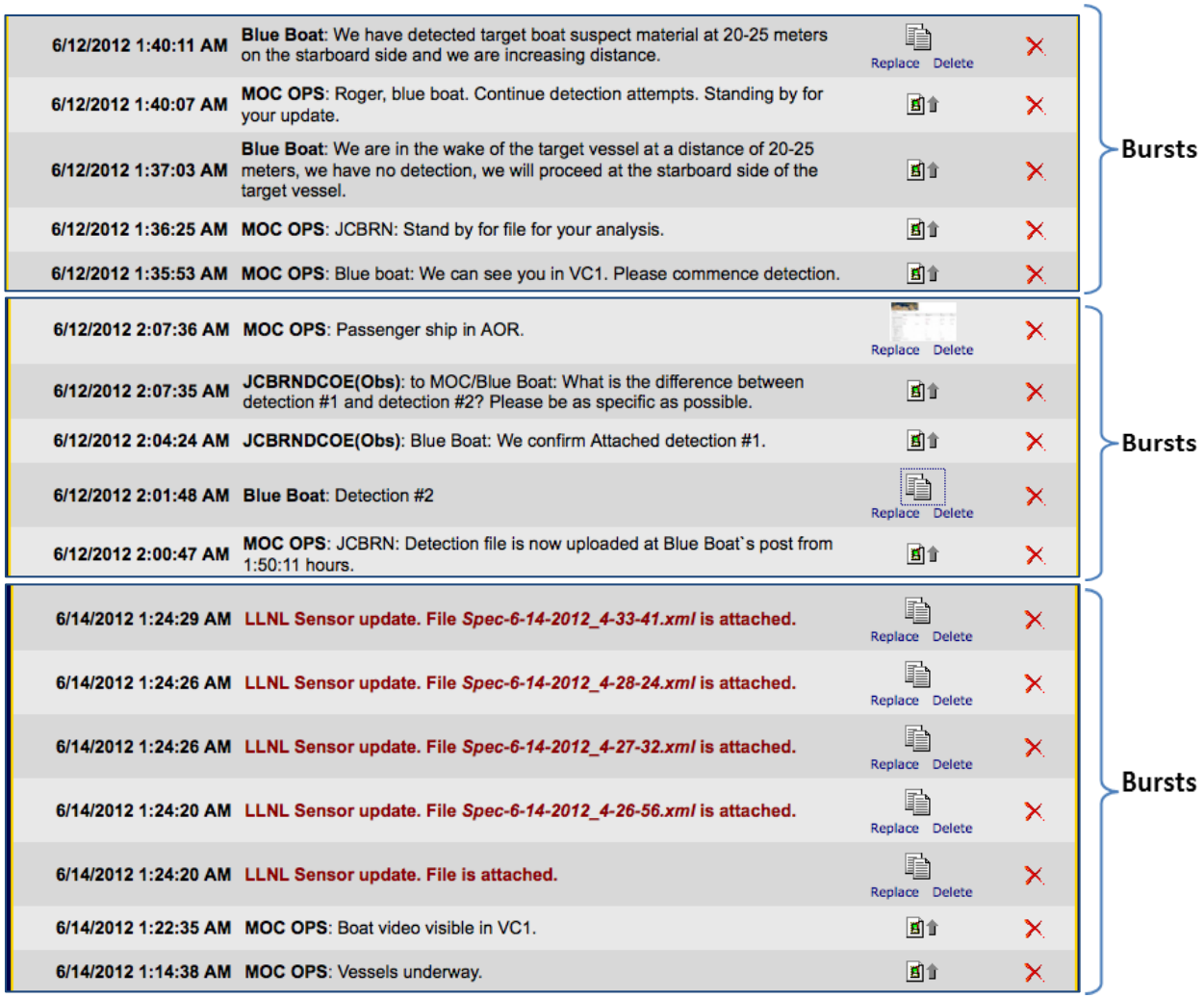
*Rodriguez, M. (2004) The hyper-cortex of human collective intelligence systems

MIO Cortex as a Whiteboard-centered Network

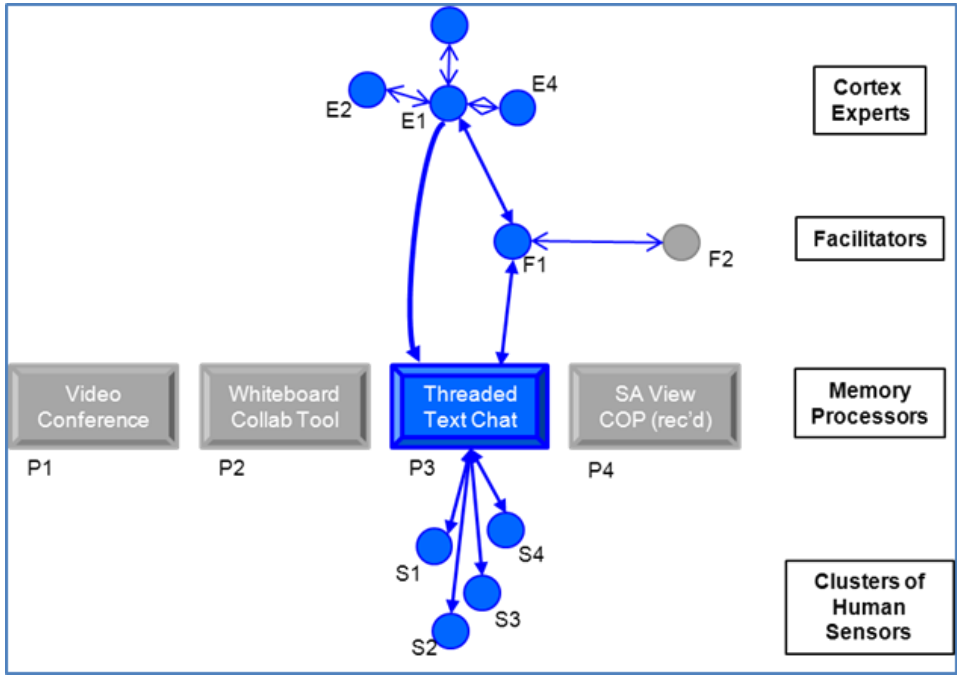


Nodes	Name	Description	Linkages
E1-E4	Cortex Experts	Members of a cluster of Subject Matter Experts	bidirectional
F1-F2	Facilitators	Stewards, connectors	-
P1-P4	Processors	The four primary MIO experimentation tools: • Video Conference – Video Conferencing Tool • Elluminate – White Board & Audio Chat Tool • Observer Notepad – Threaded Text Chat Tool • SA COP – Common Operational Picture Tool	directed
S1-S4	Sensors	Human Sensors (possibly aided by unattended sensors)	-

MIO Cortex: centered on threaded Text Chat



MIO Cortex as a Text Chat-centered Network



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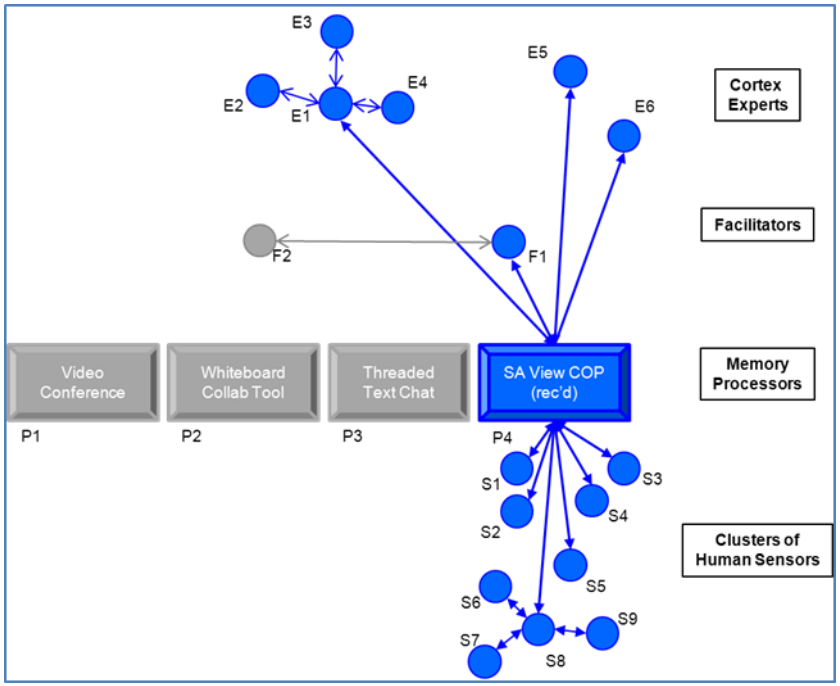
MIO Cortex actions: centered on a SA View tool

MIO Cortex as a SA view sharing Network



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Discussion

- The noticeable differences in cortex topology illustrate that the type of the *memory processor* used (i.e. the collaboration platform) defines a very different network as a cortex model of TM.
- The threaded text chat centered part of cortex sometimes keeps experts at *two degrees of separation* from the sensor nodes.
  - These links are frequently lengthened by Facilitator intervention.
- *Clustering effect* is very strong in the White Board centered part of the cortex.
  - It is noticeably defined by the changing mesh of weak and strong ties.
- These differences highlight the interesting *dynamics in MIO cortex behavior.*
  - By switching between different memory processors, i.e. collaborative platforms, we move from one knowledge flow topology to another with different combinations of strong and weak ties usage as well as facilitator roles.

Conclusion

- We describe the emergence of Transactive Memory structures for a collective network of experts and operators (sensors), based upon observations of ongoing MIO detection and interdiction experiments.
- We consider the memory mechanism supporting a MIO networked DSS environment, as a network parallel to a human cortex. The MIO cortex reveals itself through observation of its expert nodes.
- In the environment of a MIO experiment, different collaborative tools play the role of memory processors.
- These observations make subsequent experimental studies of MIO Cortex bursts and clustering interesting and challenging.